GROUNDWATER MIGRATION CONTROL SYSTEM SAUGET AREA 2 SUPERFUND SITE

Volume 2
Construction Quality Assurance Plan

Prepared for
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SECTIONONE General Organization

1.1 SCOPE

This Construction Quality Assurance Plan (CQAP) addresses the quality assurance of site development and installation of a barrier wall (including temporary spoils stockpiles), groundwater extraction wells, effluent piping, and control system used for the Interim Remedial Action associated with the Sauget Area 2 Groundwater Operable Unit located in Sauget and Cahokia, Illinois.

This manual addresses quality assurance, not quality control. In the context of this manual, quality assurance refers to means and actions employed to assure conformity of the project elements with the project-specific Plans, Specifications, contractual and regulatory requirements. Quality assurance is provided by a party independent from production and installation. Quality control refers only to those actions taken to ensure that materials and workmanship meet the requirements of the Plans and Specifications. Quality control is provided by the manufacturers and installers of the various components.

The scope of this CQA Plan applies to manufacturing, shipment, handling, and installation of materials. This CQA Plan does not address design guidelines, installation specifications, or selection of materials.

1.2 PROJECT ORGANIZATION

Solutia, Inc. (Solutia), has committed to the implementation of the requirements of a Unilateral Administration Order (UAO) issued by the U.S. EPA on October 3, 2002 covering remedial activities at the operating unit (OU). As such, Solutia is moving forward with plans to undertake the response activities presented in the UAO, the Statement of Work (SOW) and the Record of Decision (ROD). To facilitate this undertaking, a Solutia Project Manager has been identified for this effort, and a number of specialty contractors will be retained to undertake the remedial design components of the project. If and when other PRPs agree to participate on the project, Solutia will work with these parties to form a PRP group to manage and implement the work described in the UAO.

Solutia is currently taking the overall responsibility for ensuring that all construction activities fulfill the objectives of the project. Solutia will retain an independent construction management firm to coordinate all construction activities and will also retain an independent inspection firm

to provide Construction Quality Assurance services during construction activities. Figure 1-1 presents an organization chart for the project.

Key personnel, their authority and responsibilities with respect to the CQA process are as follows:

1.2.1 Solutia Project Coordinator

Gary Vandiver has been identified as the Solutia Project Coordinator. The Solutia Project Coordinator has the overall responsibility for regulatory agency interface.

1.2.2 Solutia Project Manager

Richard Williams has been identified as the Solutia Project Manager. The Solutia Project Manager will assist the Solutia Project Coordinator with contacts with the regulatory agencies for matters concerning the project and has overall responsibility for the conduct of project activities. The Solutia Project Manager will ensure that corporate standards are applied during the project and will have the overall responsibility to ensure the project meets all established QA/QC goals. The Solutia Project Manager is responsible for the coordination between the design firm and Construction Manager and serves as Solutia's representative during construction. He is also the primary point of contact between Solutia and all supporting team members.

1.2.3 Construction Manager

Richard Ashley has been identified as the Construction Manager. Acting under the authority delegated to him by Solutia, the Construction Manager is the on-site representative and will implement the overall project plans through day-to-day direction of field activities.

1.2.4 Designer

The Designer is the firm responsible for the preparation of the design, including plans and project-specific specifications for the project. URS has been identified as the Designer for the Groundwater Migration Control System (GMCS) project. Golder Associates has been identified as the Designer for the Extraction Wells.

1.2.5 Construction Quality Assurance (CQA) Consultant

The Construction Quality Assurance (CQA) Consultant will be responsible for observing and documenting activities related to the quality assurance of the project elements on behalf of Solutia. The CQA Consultant will prepare a Daily Field Report supplemented with other forms and logs as necessary which summarizes all work activities, measurements and tests associated with installation of the project elements.

The CQA Consultant is responsible for implementation of the project CQAP.

1.2.6 Contractor(s)

Selected Contractors will be responsible for performing the work outlined in the Plans and Specifications. This work will include:

- Site preparation
- Installation of a barrier wall (including temporary spoils stockpiles)
- Installation of groundwater extraction (recovery) wells
- Installation of effluent piping
- Installation of a pump control system
- Installation of groundwater monitoring wells and piezometers used to monitor system performance.

1.3 PROJECT TEAM RESPONSIBILITIES AND QUALIFICATIONS

The parties discussed in this section are associated with the ownership, design, manufacture, transportation, installation, and quality assurance of the key project elements. The qualifications and responsibilities of these parties are outlined in the following subsections.

1.3.1 Construction Manager

1.3.1.1 Responsibilities

The Construction Manager is responsible for all construction quality. The Construction Manager is responsible for the organization and implementation of the quality assurance activities for the project.

The principal responsibilities of the Construction Manager are:

- Establish effective communications with the Solutia Project Manager and Contractor field representatives, and other project team personnel through correspondence, meetings, and discussions, as required, to maintain close working relationships.
- Execute the project work plans and implement procedures through overall planning and day-to-day direction of field activities.
- Ensure that QA and QC procedures are implemented throughout execution of the work.
- Review Contractor progress reports and payments.
- Issue weekly field activity reports.
- Maintain on-site documentation consisting of procedures, rules and regulations, drawings, survey information, correspondence, meetings, etc.
- Manage and assist other field personnel in overseeing Contractors.

The Construction Manager will also be responsible for proper resolution of all quality assurance issues that arise during construction.

1.3.2 Designer

1.3.2.1 Responsibilities

The Designer is responsible for performing the engineering design and preparing the associated Plans and Specifications for GMCS project. The Designer is responsible for approving all design and specification changes and making design clarifications necessitated during construction of the project components.

1.3.2.2 Qualifications

The Designer will be a qualified engineer, certified or licensed as required by regulation. The Designer will be familiar with the project elements and applicable regulatory requirements.

1.3.2.3 Submittals

The Designer will submit the project Plans and Specifications to the Solutia Project Manager and the Construction Manager.

1.3.3 Contractor

1.3.3.1 Responsibilities

The Contractor(s) will be responsible for the installation of the various project elements, to include the barrier wall, the groundwater extraction wells, the piping and conveyance systems, the control logic systems, the groundwater monitoring wells and piezometers used to measure system performance, and all associated supporting systems. The Contractor(s) will also be responsible for ensuring that all activities are conducted in accordance with the approved Final Design documents and in compliance with all applicable laws, codes, and regulations.

1.3.3.2 Qualifications

The Contractor(s) will be pre-qualified and approved by Solutia. The Contractor(s) will be able to provide qualified personnel to meet the demands of the project, including an overall Site Superintendent. The Site Superintendent must be qualified based on previously demonstrated experience, management ability, and authority.

1.3.3.3 Submittals

Pre-qualification: to be considered for pre-qualification, the Contractor(s) will submit the pre-qualification information required by the Specifications.

Pre-construction: prior to commencement of remedial action construction activities, the Contractor(s) must submit to the Construction Manager a resume of the Site Superintendent assigned to this project, including dates and duration of employment. Additionally, a

detailed description of the approach used to accomplish this job must be submitted, including all relevant drawings and calculations, along with a project schedule.

Construction: during construction activities, the Site Superintendent must submit daily progress reports to the Construction Manager and attend daily safety and planning meetings.

1.3.4 Construction Quality Assurance Consultant

1.3.4.1 Responsibilities

The Construction Quality Assurance (CQA) Consultant is responsible for observing and documenting activities related to the quality assurance of the production and installation of the project components. The CQA Consultant is responsible for implementation of the project CQA Plan and management of the Quality Assurance Laboratory as required.

The specific duties of the CQA Consultant are as follows:

1. Reviews other site-specific documentation, including proposed layouts, and manufacturer's and installer's literature.
2. Reviews all changes to design drawings and specifications as issued by the Designer.
3. Attends all quality assurance related meetings.
4. Reviews all Manufacturer and Installer certifications and documentation and makes appropriate recommendations.
5. Reviews the Installer's personnel qualifications for conformance with the qualifications for work on site.
6. Reviews the calibration certification of any on site test equipment, if applicable.
7. Notes any on site activities that could result in damage to the project.
8. Reports to the Construction Manager, and logs in the daily report.
9. Prepares a daily summary of the construction activities.
10. Prepares the weekly summary of construction activities.

11. Oversees the marking, packaging and shipping of all laboratory test samples.

12. Reviews the results of laboratory testing and makes appropriate recommendations.

13. Reports any unapproved deviations from the CQA Plan to the Construction Manager.

1.3.4.2 Qualifications

The CQA Consultant will be pre-qualified by Solutia. The CQA Consultant will be experienced in the preparation of quality assurance documentation including: quality assurance forms, reports, certifications, and manuals.

1.4 COMMUNICATION

To guarantee a high degree of quality during installation and assure a final product that meets all project specifications; clear, open channels of communication are essential. This section issues appropriate lines of communication and describes necessary meetings.

1.4.1 Resolution Meeting

Following the completion of the construction drawings and specifications for the project, a resolution meeting may be held. If a resolution meeting is required, it is recommended that the meeting be held prior to bidding the construction work and include all parties then involved, typically including the Solutia Project Manager, Construction Manager, Designer, CQA Consultant, key members from the Contractor's firm and regulatory agencies. If necessary, this meeting can be held in conjunction with the pre-construction meeting.

The purpose of this meeting is to establish lines of communication, review construction drawings and specifications for completeness and clarity, begin planning for coordination of tasks, and anticipate any problems which might cause difficulties and delays in construction. All aspects of the design will be reviewed during this meeting so that clarification and/or design changes may be made before the construction work is bid. In addition, the guidelines regarding quality assurance testing and problem resolution must be known and accepted by all.

The meeting will be documented by the Construction Manager and minutes will be transmitted to all parties.

1.4.2 Pre-construction Meeting

A pre-construction meeting will be held at the site prior to beginning remedial action implementation. Typically, the meeting will be attended at a minimum by the Solutia Project Manager, Construction Manager, Designer, CQA Consultant, key members from the Contractor's firm and regulatory agencies.

Specific topics considered for this meeting include review of the project CQA Plan for any problems or additions. In addition, the responsibilities of each party should be reviewed and understood clearly. The meeting will be documented by the Construction Manager and minutes will be transmitted to all parties.

1.4.3 Progress Meetings

A progress meeting will be held at least weekly between the Contractor's Superintendent, CQA Consultant, Construction Manager, and any other concerned parties. This meeting will discuss current progress, planned activities for the next week, issues requiring resolution, and any new business or revisions to the work. The Construction Manager will log any problems, decisions, or questions arising at this meeting in his weekly report. If any matter remains unresolved at the end of this meeting, the Construction Manager will be responsible for the resolution of the matter and the communication of the decision to the appropriate parties.

1.5 DOCUMENTATION

An effective CQA Plan depends largely on recognition of all construction activities that should be monitored, and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA Consultant will document that all quality assurance requirements have been addressed and satisfied.

The CQA Consultant will provide the Construction Manager with signed descriptive remarks, data sheets, and checklists to verify that all monitoring activities have been carried out. The Construction Manager will also maintain at the job site a complete file of Drawings and specifications, a CQA Plan, checklists, test procedures, daily logs, and other pertinent documents.

Specific forms will be developed by the CQA Consultant for each project work element after the final design and construction methods are approved.

1.5.1 Daily Recordkeeping

Standard reporting procedures will include preparation of a daily log which, at a minimum, will consist of: a) field notes; including memorandum of meetings and/or discussions with the contractor, b) observation and testing data sheets, and c) construction problem and solution data sheets. This information will be regularly submitted to and reviewed by the Construction Manager.

1.5.1.1 Memorandum of Discussion With Contractor or Subcontractors

A memorandum will be prepared each day as necessary, summarizing discussions between the CQA Consultant and Contractor. At a minimum, the memorandum will include the following information:

- Date, project name, location, and other identification
- Names of parties to discussion
- Relevant subject matter or issues
- Activities planned
- Constraints or suggestions
- Schedule
- Signature of the CQA Consultant.

1.5.1.2 Observation and/or Testing Data Sheets

Observation and/or testing data sheets will be prepared daily. At a minimum, these data sheets will include the following information:

- An identifying sheet number for cross referencing and document control
- Date, project name, location, and other identification
- Data on weather conditions
- A reduced-scale site plan showing all proposed work areas and test locations

- Descriptions and locations of ongoing construction
- Equipment and personnel in each work area, including subcontractors
- Descriptions and specific locations of areas, or units, of work being tested and/or observed and documented
- Locations where tests and samples (if required) were taken
- A summary of test results (if required)
- Calibrations or re-calibrations of test equipment, and actions taken as result of re-calibration (if required)
- Off-site materials received, including quality verification documentation
- Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality
- The CQA Consultant signature.

1.5.2 Construction Problem and Resolution Data Sheets

Sheets describing special construction situations will be cross-referenced with specific observation and testing data sheets, and must include the following information, where available:

- An identifying sheet number for cross-referencing and document control
- A detailed description of the situation or deficiency
- The location and probable cause of the situation or deficiency
- How and when the situation or deficiency was found or located
- Documentation of the response to the situation or deficiency
- Final results of any responses
- Any measures taken to prevent a similar situation from occurring in the future
- The signature of the CQA Consultant and signature indicating concurrence by the Construction Manager.

The Construction Manager will be made aware of any significant recurring non-conformance with the Specifications. The Construction Manager will then determine their cause and recommend appropriate changes in procedures or Specifications. When this type of evaluation is made, the results must be documented, and any revision to procedures or Specifications will need approval by the Designer.

A summary of all supporting observation and test data sheets (if required) and the CQA Consultant's concurrence that the work is completed in accordance with the requirements of the Drawings and Specifications, will be required upon completion of the repair, replacement or resolution of the issue.

1.5.3 Photographic Reporting Data Sheets

Photographic reporting data sheets, where used, will be cross-referenced with observation and testing data sheet(s) and/or construction problem and solution data sheet(s).

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain color prints; negatives and/or discs with electronic files will also be stored in a separate file in chronological order.

1.5.4 Design and/or Specifications Changes

Design and/or specifications changes may be required during construction. In such cases, the CQA Consultant will notify the Construction Manager and Designer.

Design and/or specifications changes will be made only with written agreement of the Construction Manager and the Designer, and will take the form of an addendum to the Specifications.

1.5.5 Progress Reports

The Construction Manager will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report will include the following information:

- A unique identifying sheet number for cross-referencing and document control
- The date, project name, location, and other information

- A summary of work activities during progress reporting period
- A summary of construction situations, deficiencies, and/or defects occurring during progress reporting period
- A summary of test results, failures and retests
- The signature of the Construction Manager.

1.5.6 Certification and Summary Report

At the completion of the work, the CQA Consultant will submit to the Construction Manager a final certification and summary report. This report will certify that the work has been performed in compliance with the Drawings and Specifications.

At a minimum, this report will include: a) summaries of all construction activities, b) observation and testing data sheets including sample location drawings, c) construction problems and resolutions data sheets, d) changes in design and material specifications, e) as-built drawings, and f) certification statement sealed and signed by a registered professional engineer. The as-built drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the as-built drawings will be done by a qualified land surveyor.

1.6 STORAGE OF RECORDS

The CQA file will be the central repository for documents which constitute evidence relevant to sampling, analysis and documentation activities as described in this CQAP. The CQA Consultant is the custodian of the CQA file and maintains the contents including, but not limited to the following:

- CQA Field notebooks, logs and data
- Daily Field Reports (DFRs)
- Pictures and drawings
- Progress reports

- Contractor and subcontractor CQC logs and reports
- Correspondence related to CQC and CQA activities.

The CQA file must be maintained on site in a secured, limited access area until the project is complete. The CQA file will be maintained similarly off site for a minimum of six years after the submittal date of the final report.

SECTION TWO Site Development

Ancillary site development activities will be required to prepare the site for the installation of the wells, barrier wall, and pipeline. Generally, site development activities will be relatively minor construction activities on this project. In the case of Earthwork, the paragraphs in this section have also been referenced within Section 3, Barrier Wall/Temporary Spoils Stockpile.

Site development activities addressed by this CQAP include:

- Stormwater Control Measures
- Reclamation of Disturbed Areas
- Excavation
- Earthwork.

2.1 ORGANIZATION, KEY PERSONNEL, AND RESPONSIBILITIES

Generally, key personnel, their authority and responsibilities with respect to the CQA process were discussed above in Section 1.

2.1.1 Proposed Monitoring, Sampling, and Testing

2.1.1.1 Stormwater Control Measures

As stated on the Drawings, a Stormwater Pollution Prevention Plan (SWPPP) that meets the requirements of the National Pollutant Discharge Elimination System (NPDES) and State of Illinois regulations will be prepared by the contractor and submitted to Solutia for approval prior to starting any activities. The SWPPP will include the design, construction, operations and maintenance of a run-off management system to collect, control and treat contact water volume resulting from a 24-hour, 25-year storm. The contractor must also design, construct, operate and maintain a run-on control system capable of preventing flow onto the temporary stockpile during the peak discharge from at least a 25-year storm.

The CQA Consultant will observe and document that all features of the SWPPP are in place and in accordance with the SWPPP during construction including, but not limited to, the following:

- Silt fence
- Check dams
- Damming of existing drainages for collection
- Sediment and retention basins and/or other treatment systems.

2.1.1.2 Reclamation of Disturbed Areas

Activities will generally include reclaiming disturbed areas along the barrier wall, staging and stockpile areas, and other disturbed areas as directed by the Construction Manager.

The CQA Consultant will review submittals for seed, seeding procedure, fertilizing, and mulching as required in the Specifications and determine if they are acceptable. The CQA Consultant will review the manufacturer's certifications and labels upon delivery to the site to determine that the materials are delivered as submitted and approved. The CQA Consultant will observe and document that the seeding, fertilizing and mulching are performed in accordance with the Specifications.

Observations and documentation will include:

- Proper bag labeling
- Condition of seed, fertilizer and mulch
- Areas have been properly prepared prior to reclamation
- Areas are to lines and grades shown on the Drawings, or as directed by the Construction Manager prior to reclamation
- Proper methods
- Acceptable weather conditions
- Protection of seeded areas
- Time of seeding operation.

2.1.1.3 Excavation

The CQA Consultant will conduct visual inspection of bottom of excavation and foundation bearing surfaces to determine if the conditions meet the requirements of the Specifications and Drawings.

All excavation and foundation subgrades will be approved by the CQA Consultant. Soft or yielding areas, as determined by the CQA Consultant, will be excavated and repaired by the Contractor.

2.1.1.4 Earthwork

Construction of the fill will be to the lines and grades shown on the Drawings and as indicated in the Specifications. Compliance is confirmed by checking that: 1) the earthen backfill materials will exhibit the required characteristics, and 2) the placement techniques used by the Contractor meet the requirements of the Specifications. CQA related activities for construction of the earth fill will include observation, testing and documentation of the pre-construction testing for material evaluation and construction testing.

2.1.1.4.1 Material Evaluation

Prior to construction, sources for the material will be identified, and samples of each material from each source will be tested in accordance with the Specifications. All material evaluation tests are to be performed as part of the Earthwork Contractors QC activities by a geotechnical laboratory approved for use by the Construction Manager and CQA Consultant.

All tests will be documented, and the material will be accepted or rejected according to the results of these tests based on the requirements of the Specifications. The CQA Consultant will confirm if required tests were performed and that the test results appear valid. If the results appear questionable he will direct the Contractor to perform additional testing. Independent testing will be performed as deemed appropriate by the CQA Consultant or as otherwise directed by the Construction Manager.

The Earthwork Contractor will furnish representative samples of the proposed fill to the CQA Consultant and Construction Manager for each material source he may use. In addition the results of the following tests will be provided to the CQA Consultant and Construction Manager for approval prior to procurement, importing or stockpiling the materials:

Moisture Content	ASTM D 2216
Atterberg Limits	ASTM D 4318

Particle Size	ASTM D 1140
Moisture Density Relationship	ASTM D 698

Off-site borrow will be sampled and analyzed for TCL/TAL constituents. Results will be compared to TACO Tier I criteria for commercial/industrial area soils. Soil with concentrations higher than these levels will not be accepted for use in temporary stockpile berm construction.

2.1.1.4.2 Earth Fill Material Management

As the material is excavated from an approved borrow facility, the CQA Consultant will confirm that the soils meet the requirements of the Specifications. The CQA Consultant will use his/her experience with visual/manual soil classification techniques to assess the segregation of soils. The CQA Consultant will note in his/her field records changes in odor, texture, apparent moisture, and the depths of which they occur. The CQA Consultant will confirm that adequate processing, as described in the Specifications, is performed for removal of roots, rocks, rubbish or unsuitable materials, and achieve the specified soil clod size.

Materials will be stockpiled in areas approved by the Construction Manager and protected. If excavated soils exhibit distinct characteristic changes with depth, the CQA Consultant should verify that stockpiles be segregated by depth, and the depth range of the stockpiles be recorded and posted. Each stockpile will be identified, and the CQA Consultant should prepare a field drawing of stockpile locations.

2.1.1.4.3 Construction Quality Evaluation

Construction quality evaluation will be performed on all components of the construction. Criteria to be used for determination of acceptability of the construction work will be as identified in the Specifications.

The Contractor will be responsible for implementing a Construction Quality Control program (CQC) to ensure that all earthwork is performed in accordance with the Drawings and Specifications. The CQA Consultant will oversee the Contractor's CQC plan and will document and observe the construction activity. Laboratory and field tests will be

performed by the Contractor in accordance with the requirements of the Drawings and Specifications.

The CQA Consultant will observe the CQC testing and review all test results from both laboratory and field-testing. He will confirm that the minimum testing is performed in accordance with the Specifications. He will confirm that the CQC testing results adequately indicate that earthwork construction meets or exceeds design requirements in accordance with the Drawings and Specifications.

Questions concerning the accuracy of any single test will be addressed by retesting in the same or adjoining locations. Additional testing will be used at the discretion of CQA Consultant and/or the Construction Manager when visual observations indicate a potential problem. Additional testing for suspect areas will be considered when:

- Compactor slippage is noted during rolling operation
- Lift thickness is greater than specified
- Earth fill is at improper and/or variable moisture content
- Less than specified number of compactor (roller) coverages are made
- Dirt-clogged rollers are used to compact the material
- Rollers may not have used optimum ballast
- Fill materials differ substantially from those specified; and the degree of compaction is doubtful.

During construction, the frequency of testing may also be increased in the following situations:

- Adverse weather conditions
- Breakdown of equipment
- At the start and finish of grading
- Materials fail to meet specifications
- The work area is reduced.

2.1.1.4.4 Deficiencies

If a deficiency is discovered in the work, the CQA Consultant will immediately determine the extent and nature of the deficiency. If the deficiency is indicated by an unsatisfactory test result, the CQA Consultant will determine the extent of the deficient area by directing the Contractor to perform additional tests, observations, a review of records, or other appropriate methods. If the deficiency is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Consultant will define the limits and nature of the deficiency.

After determining the extent and nature of a deficiency, the CQA Consultant will notify the Construction Manager and Contractor.

The Contractor will correct the deficiency to the satisfaction of the Construction Manager. If a requirement cannot be met, or unusual weather conditions hinder work, then the CQA Consultant, Construction Manager and Contractor will discuss alternate solutions and a schedule for correction of the deficiency.

All retests performed by the Contractor, as directed by the CQA Consultant, must confirm that the deficiency has been corrected before any additional work is performed in the area of the deficiency. The CQA Consultant will also confirm that all installation requirements are met and that all CQC submittals are provided.

2.1.1.4.5 Acceptance

The CQA Consultant will recommend to the Construction Manager acceptance of the work performed by the Contractor. Acceptance of the completed work will be in accordance with the requirements of the Drawings and Specifications. Acceptance of the earth fill will be based on observation, measurements and laboratory test results.

The following methods will be used by the CQA Consultant as the basis to judge the acceptability of the construction of the earth fill.

Evaluate the following for a given lift or section:

- Dry density

- Moisture content
- Lift thickness
- Clod size
- Compare measured results to Specification requirements and determine the variation
  - If dry density is too low, adjust moisture content as necessary and recompact lift
  - If moisture content is too dry/wet: adjust moisture content and recompact
  - If lift is too thick: decrease thickness, check dry density and moisture at bottom of lift
  - If clod size is too large: inspect test pit(s) to determine integrity of lift and layer bonding.

If two or more items fail to comply, then the lift or section being assessed will be deemed unacceptable and will be suitably broken up, moisture content adjusted, recompacted and retested.

SECTIONTHREE Barrier Wall/Temporary Spoils Stockpiles

3.1 SCOPE

This section includes the Construction Quality Assurance Plan (CQAP) for construction of a groundwater barrier wall. The barrier will consist of soil mixed with bentonite and possible additive(s), constructed by the slurry wall method, or approved alternate method. Installation procedures should be as required to produce a continuous, relatively impermeable barrier. The project also involves the construction of a temporary stockpile to handle spoil materials resulting from site activities. Alternate installation techniques may be proposed by the Contractor. The following items must be included in a proposed alternate, but will not be required for a soil-bentonite barrier wall:

1. Installing one or more pre-construction test cells and performing pumping tests to determine the optimal construction parameters (mix design, injection pressures, spacing of injection points, and withdrawal rate of the injection bit).
2. Installing two test cells at selected points along the wall and conducting pump tests to ensure the maximum average permeability requirement is met in accordance with the specifications.

3.2 ORGANIZATION, KEY PERSONNEL, AND RESPONSIBILITIES

3.2.1 Qualifications of Key Personnel

Generally, key personnel, their authority and responsibilities with respect to the CQA process were discussed above in Section 1.

3.3 BARRIER WALL

3.3.1 Submittals

The Contractor will provide submittals on proposed equipment, materials, procedures, and qualifications in accordance with the Specifications. The Construction Manager and Designer will review the submittals and evaluate their compliance with the Contract requirements. The CQA Consultant will also review the submittals to obtain an understanding of the work plan, equipment, schedule, layout, backfill mix design, and Construction Quality Control (CQC) procedures as well as documentation to be provided by the Contractor. CQA procedures will be improved and/or otherwise modified as necessary to account for the Contractor's proposed methods as approved.

3.3.2 Protocols for Testing and Test Frequency

3.3.2.1 Field Testing and Measurement

Pre-Production Test Cells and Production Test Cells, if an Alternate Installation Technique is Proposed. Pre-Production Test Cells and Production Test Cells, dewatering wells, and pumping tests will be installed and performed. The Designer will evaluate the results of the tests and report on the effectiveness of the test cell installation. After the Pre-production test cell is evaluated, revisions in the design and/or installation procedure will be made if necessary and additional test cells will be installed until an acceptable installation procedure has been identified. A meeting will be held between the parties as described in Section 1.4.1 resolution meeting to approve the design and wall construction methods. CQC and CQA records of the test cells will be kept as indicated for the production wall in the Specifications and herein. These measurements will provide data for control of the production installation. The Production test cells will demonstrate the effectiveness of the installation of the actual wall. In the event that the production test cells demonstrate that the wall installation is not adequate, the design and/or installation procedure will be revised and additional test cells will be installed until an acceptable installation is identified. Any discontinuities or unsatisfactory areas identified during testing of the production cells will be repaired by the contractor.

Location of Elements. As indicated in the Specifications, locations of the barrier wall alignment will be surveyed and checked by the Contractor. The CQA Consultant will review the surveyed wall location as well as monitor measurement and document that the Contractor has surveyed or otherwise accurately located and documented the barrier wall location.

Inclinations. The inclination of the wall will be controlled to the accuracy indicated in the specifications and checked frequently during excavation. The Contractor will demonstrate to the CQA Consultant that measurement of plumbness to the accuracy required in the Specifications can be made and maintained during construction. The CQA consultant will monitor measurement and document that the checks are performed.

Element Depth and Height. The depth and height of the barrier wall will be constructed as shown on the Drawings and controlled as indicated in the Specifications. The CQA

Consultant will monitor and document that the Contractor has accurately measured and documented the top and bottom per the specification.

Slurry and Backfill Mixing. The mixing procedures and design proportions will be in accordance with approved submittals and as modified based on the evaluation of Test Cells, if necessary, as indicated in the Specifications. During production backfilling, backfill placement rates, backfill volumes, and backfill uniformity tests will be monitored and documented by the Contractor as indicated in the Specifications. The CQA Consultant will monitor and document that the Contractor has accurately recorded these measurements and performed the tests.

3.3.2.2 Laboratory Testing

The Contractor's QC testing of the backfill mix for uniformity will be verified by performing laboratory tests as indicated in the Specifications. The Contractor will provide an onsite QC laboratory, personnel and equipment capable of performing these tests in a timely manner during production. The CQA Consultant will monitor and document that the Contractor has performed these tests in accordance with the Specifications.

3.3.2.3 Acceptance/Rejection Criteria

Backfill mix design and barrier wall installation methods will be evaluated by the Solutia Project Manager, Construction Manager and Designer during the submittal process. The mix design will demonstrate a minimum unconfined compressive strength and maximum average hydraulic conductivity as indicated in the specifications based on laboratory tests on the selected grout-soil mix during mix design testing. The maximum average hydraulic conductivity of the in-place barrier wall will be demonstrated by performing pumping tests within test cells for alternate installation techniques if proposed.

Horizontal survey measurements for the wall location and location of wall elements will be to the nearest 0.1 foot. Inclination tolerance for the wall elements will be as indicated in the Specifications. Vertical measurements of the installed top and bottom of the wall elements will be to the nearest 0.5 foot elevation.

Tolerances for the backfill mixing and placement techniques will be developed during the mix design process to determine an acceptable backfill mix design and installation procedure.

3.4 TEMPORARY SPOILS STOCKPILES

3.4.1 Scope

Temporary stockpiles will be constructed on the existing landfill to handle the spoils from the wall installation as shown on the Drawings and indicated in the Specifications. Generally, construction of the stockpiles will include placement of clean soil berms at the perimeter of the stockpile area. During construction, spoils will be covered with a thin polyethylene Daily Cover to control erosion, dust, etc. When the wall construction and stockpiles are complete, an Interim Cover of continuous HDPE liner material will be installed over the stockpile. This CQAP will address the soil berms, compacted spoils, Daily Cover, and Interim Cover components.

3.4.2 Proposed Sampling and Testing

3.4.2.1 Soil Berms

Construction of the soil berms will be to the lines and grades shown on the Drawings and as indicated in the Specifications.

CQA requirements will be as indicated above in Section 2, Site Development, Paragraph 2.1.1.4 Earthwork.

3.4.2.2 Compacted Spoils Materials

The Contractor will be required to locate and size slurry pits as necessary adjacent to the barrier wall to contain spoil materials. The Contractor will be required to provide a material-handling plan for the slurry that is produced by the installation of the barrier wall. It is anticipated that the Contractor will allow the slurry to harden before transporting and placing in the temporary spoils stockpile on the landfill. Placement of liquids in the temporary stockpile will not be permitted.

Placement of the spoils will be to the lines and grades shown on the Drawings and as indicated in the Specifications. Compliance is confirmed by checking that the placement techniques used by the Contractor will be adequate. CQA related activities for placement of compacted spoils will include construction observation as required by the Specifications and discussed below.

3.4.2.2.1 Spoils Material Management

As the solid spoil material is excavated from the excavation and slurry pits, the CQA Consultant will confirm that the material meets the requirements of the Specifications. The CQA Consultant will use his/her experience with visual/manual soil classification techniques to assess the quality of the spoils material. The material must demonstrate that it has adequately hardened (or set) such that it can be transported to the temporary stockpile and compacted in place.

3.4.2.2.2 Construction Quality Evaluation

The Contractor will be responsible for implementing a Construction Quality Control program (CQC) to ensure that the spoils placement is performed in accordance with the Drawings and Specifications. The CQA Consultant will oversee the Contractor's CQC plan and will document and observe the construction activity.

Monitoring and observation will be performed by the Contractor in accordance with the requirements of the Drawings and Specifications.

The CQA Consultant will observe the CQC monitoring and will review all CQC documentation. He will confirm that the minimum monitoring is performed in accordance with the Specifications.

Additional compaction effort will be used at the discretion of CQA Consultant and/or the Construction Manager when visual observations indicate a potential problem. Additional effort for suspect areas will be considered when:

- Lift thickness is greater than specified
- Spoils are at improper and/or variable moisture content
- Less than specified number of coverages are made
- Materials differ substantially from those anticipated or specified; and the degree of compaction is doubtful.

During construction, compaction effort may also be increased in the following situations:

- Adverse weather conditions

- Breakdown of equipment
- At the start and finish of grading
- Materials fail to meet specifications
- The work area is reduced
- Visual observations indicate inadequate strength or excessive deformation under equipment weight.

3.4.2.2.3 Deficiencies

If a deficiency is discovered in the work, the CQA Consultant will immediately determine the extent and nature of the deficiency. If the deficiency is related to adverse site conditions, such as overly wet spoils, the CQA Consultant will define the limits and nature of the deficiency.

After determining the extent and nature of a deficiency, the CQA Consultant will notify the Construction Manager and Contractor.

The Contractor will correct the deficiency to the satisfaction of the Construction Manager. If a requirement cannot be met, or unusual weather conditions hinder work, then the CQA Consultant, Construction Manager and Contractor will discuss alternate solutions and a schedule for correction of the deficiency.

The CQA Consultant must confirm that the deficiency has been corrected before any additional work is performed in the area of the deficiency. The CQA Consultant will also confirm that all installation requirements are met and that all CQC submittals are provided.

3.4.2.2.4 Acceptance

The CQA Consultant will recommend to the Construction Manager acceptance of the work performed by the Contractor. Acceptance of the completed work will be in accordance with the requirements of the Drawings and Specifications. Acceptance of the compacted spoils will be based on observation and measurements.

The following methods will be used by the CQA Consultant as the basis to judge the acceptability of the compacted spoils:

Evaluate the following for a given lift or section:

- Lift thickness
- Clod size
- Compare measured results to Specification requirements and determine the variation
  - If lift is too thick: decrease thickness
  - If clod size is too large: reduce clod size by discing; inspect test pit(s) to determine integrity of lift and layer bonding.

If the lift or section being assessed is unsatisfactory it will be suitably broken up, moisture content adjusted, and recompacted.

3.4.2.3 Daily Cover

This section of the CQAP addresses the quality assurance of the installation of Daily Cover material used for capping spoils.

During construction, a Daily Cover will be placed over the spoils stockpile at the end of each workday, during inclement weather, or generally any time the spoils stockpile is not active to control erosion, dust and minimize the amount of rainfall runoff that comes into contact with the spoils. In addition, the Daily Cover material should be maintained until an interim cover is installed is installed by the owner.

The Daily Cover will consist of 6-mil thick polyethylene or approved equal such as "visqueen" plastic used to temporarily protect construction activity by contractors. Placement and maintenance of this material will require attention by the Contractor to ensure it served its intended function. However, it will not require a CQA or CQA Plan. The Construction Manager will perform monitoring of installation, and maintenance of the Daily Cover. The Contractor will install and maintain the Daily Cover to the satisfaction of the Construction Manager.

3.4.2.4 HDPE Interim Cover

This section of the CQAP addresses the quality assurance of the installation of HDPE Liner material used for capping the spoils stockpile.

The scope of this section applies to manufacturing, shipment, handling, and installation.

3.4.2.4.1 Qualifications of Key Personnel and Responsibilities

Key personnel, their authority and responsibilities with respect to the CQA process for the barrier wall in general were discussed above in Section 3.2. Additional entities for the HDPE cap are as follows:

Manufacturer

The Manufacturer is a firm responsible for production of the HDPE liner material outlined in the Specifications.

Responsibilities

The Manufacturer is responsible for the production of its HDPE. In addition, the Manufacturer is responsible for the condition of the material until it is accepted by the Construction Manager after delivery. The Manufacturer will produce a consistent product meeting the Specifications. The Manufacturer will provide quality control documentation for its product as specified in the Specifications.

Qualifications

The Manufacturer will be pre-qualified by Solutia. The Manufacturer will provide sufficient production capacity and qualified personnel to meet the demands of the project. The Manufacturer will have an internal quality control program for its product that meets standard industry requirements.

Submittals

Pre-qualification: The Manufacturer will meet the following requirements and submit the following information:

- A list of material properties including certified test results, to which are attached HDPE samples.
- The origin (supplier's name and production plant) and identification (brand name and number) of resin used to manufacture the product.

Pre-installation: Prior to the installation of HDPE material, the Manufacturer must submit to the Construction Manager all quality control documentation required by the Specifications. This documentation will be reviewed by the Construction Manager before installation can begin.

Installer

The Installer is the firm responsible for installation of the HDPE. The Installer may be affiliated with the Manufacturer.

The Superintendent is responsible for the Installer's field crew. The Superintendent will represent the Installer at all site meetings and will be responsible for acting as the Installer's spokesman on the project.

The Master Seamer will be the most experienced seamer of the Installer's field crew. The Master Seamer will provide direct supervision over less experienced seamers.

Responsibilities

The Installer will be responsible for field handling, storing, deploying, seaming, temporary restraining and all other aspects of the HDPE installation. The Installer may also be responsible for transportation of these materials from on-site storage to the area of the work.

Qualifications

The Installer will be pre-qualified and approved by Solutia. The Installer will be able to provide qualified personnel to meet the demands of the project. At a minimum, the Installer will provide a Superintendent and a Master Seamer as described herein. The Superintendent and Master Seamer must be qualified based on previously demonstrated experience, management ability, and authority. All personnel performing seaming operations will be qualified by experience or by successfully passing seaming tests using the equipment and seaming techniques proposed for this project.

Submittals

Pre-qualification: To be considered for pre-qualification, the Installer will submit the pre-qualification information required by the Specifications.

Pre-installation: Prior to commencement of the installation, the Installer must submit to the Construction Manager:

- Resume of the Superintendent to be assigned to this project, including dates and duration of employment.
- Resume of the Master Seamer to be assigned to this project, including dates and duration of employment.
- A panel layout drawing showing the installation layout identifying field seams as well as any variance or additional details which deviate from the engineering drawings. The layout will be adequate for use as a construction plan and will include dimensions, details, etc.
- Installation schedule.
- A list of personnel performing field seaming operations along with pertinent experience information.
- All quality control certificates as required by this CQAP and the Specifications (unless submitted directly to the Construction Manager by the Manufacturer).
- Certification that extrudate to be used is comprised of the same resin as the HDPE to be used.

This documentation will be reviewed by the Construction Manager before installation of the geosynthetic can begin.

Installation: During the installation, the Installer will be responsible for the submission of:

- Quality control documentation recorded during installation.
- Subgrade surface acceptance certificates for each area to be covered by the lining system, signed by the Installer.

Completion: Upon completion of the installation, the Installer will submit:

- The warranty obtained from the Manufacturer.
- The installation warranty.

Construction Quality Assurance Consultant

The specific duties of the CQA Consultant personnel are as follows for HDPE Interim Cover installation:

- Reviews other site-specific documentation, including proposed layouts, and manufacturer's and installer's literature.
- Reviews all changes to design drawings and specifications as issued by the Designer.
- Attends all quality assurance related meetings.
- Reviews all Manufacturer and Installer certifications and documentation and makes appropriate recommendations.
- Reviews the Installer's personnel qualifications for conformance with the qualifications for work on site.
- Reviews the calibration certification of the on-site tensiometer, if applicable.
- Notes any on site activities that could result in damage to the HDPE.
- Reports to the Construction Manager, and logs in the daily report.
- Prepares a daily summary of the quantities of HDPE installed that day.
- Prepares the weekly summary of HDPE quality assurance activities.
- Oversees the marking, packaging and shipping of all laboratory test samples.
- Reviews the results of laboratory testing and makes appropriate recommendations.
- Reports any unapproved deviations from the CQA Plan to the Construction Manager.
- Prepares the final certification report.

Quality Assurance Laboratory (QAL)

Responsibilities

The QAL will be responsible for conducting the appropriate laboratory tests as directed by the CQA Consultant or the Construction Manager. The test procedures will be done in accordance with the test methods outlined in the Drawings and Specifications. The QAL will be responsible for providing test results.

Qualifications

The QAL will have experience in testing HDPE liner materials and be familiar with American Society for Testing and Materials (ASTM), and other applicable test standards. The QAL will be capable of providing verbal results of destructive seam tests within 24 hours of receipt of test samples and will maintain that standard throughout the installation. The QAL will be approved by the Solutia Project Manager.

On-site laboratory facilities may be used by the QAL provided they are appropriately equipped and approved by the CQA Consultant and the Construction Manager.

Submittals

HDPE destructive test results will typically be provided verbally to the Construction Manager within 24 hours of receipt of test samples. The QAL will submit all destructive seam test results to the Construction Manager in written form within 48 hours of receipt of test samples unless otherwise specified by the Construction Manager. Written test results will be in an easily readable format and include references to the standard test methods used.

3.4.2.4.2 Quality Control Documentation

Prior to the installation of any HDPE material, the Manufacturer or Installer will provide the Construction Manager with the following information:

- The origin (resin suppliers name and resin production plant), identification (brand name and number), and production date of the resin.
- Copies of the quality control certificates issued by the resin supplier.

- Reports on tests conducted by the Manufacturer to verify that the quality of the resin used to manufacture the HDPE meets the Specifications.
- Reports on quality control tests conducted by the Manufacturer to verify that the HDPE manufactured for the project meets the project specifications.
- A statement indicating that no reclaimed polymer was added to the resin during manufacturing.
- A list of the materials with which comprise the HDPE, expressed in the following categories as percent by weight: polyethylene, carbon black, other additives.
- Written certification that minimum values given in the specification are guaranteed by the Manufacturer.
- Quality control certificates, signed by a responsible party employed by the Manufacturer. Each quality control certificate will include roll identification numbers, sampling procedures, and results of quality control tests. At a minimum, results will be for:
  - Density
  - Carbon black content
  - Carbon black dispersion
  - Thickness
  - Tensile properties
  - Tear resistance.

These quality control tests will be performed in accordance with the frequency and test methods in the Specifications.

The Manufacturer will identify all rolls of HDPE with the following:

- Manufacturer's name
- Product identification
- Thickness

- Roll number
- Roll dimensions.

The CQA Consultant will review these documents and will report any discrepancies with the above requirements to the Construction Manager. The CQA Consultant will verify that:

- Property values certified by the Manufacturer meet all of its guaranteed performance criteria. Measurements of properties by the Manufacturer are properly documented and that test methods used are acceptable.
- Quality control certificates have been provided at the specified frequency for all rolls and that each certificate identifies the rolls related to it.
- Rolls are appropriately labeled.
- Certified minimum properties meet the requirement of the Specifications.

3.4.2.4.3 Subgrade Preparation

The Contractor will be responsible for preparing the supporting leveling layer of soil and spoils material for HDPE placement. The Construction Manager will coordinate the work of the Contractor and the HDPE Installer so that the requirements of the Specifications and the project CQA Plan are met.

Before the HDPE installation begins, the CQA Consultant will verify that:

- A qualified land surveyor has verified all lines and grades.
- A qualified geotechnical engineer has verified that the supporting soil and spoils material meets the density specified in the project specifications.
- The surface to be lined has been rolled, compacted, or hand-worked so as to be free irregularities, protrusions, loose soil and abrupt changes in grade. Bedding layer soils will have a moisture content at or near optimum. Bedding layers will be smooth with no large clods, ruts or sharp edges before, during and after installation of the overlying HDPE. They will provide a surface capable of supporting the HDPE.

- The surface of the supporting soil does not contain stones which may be damaging to the HDPE.
- There is no area excessively softened by high water content.
- There is no area where the surface of the soil contains desiccation cracks with dimensions exceeding those allowed by the Specifications.

The Installer will certify in writing that the surface on which the HDPE will be installed is acceptable. A certificate of acceptance will be given by the Installer to the CQA Consultant and Construction Manager prior to commencement of HDPE deployment in the area under consideration.

After the supporting soil has been accepted by the Installer, it is the Installer's responsibility to indicate to the Construction Manager any change in the supporting soil condition that may require repair work. The Construction Manager may consult with the CQA Consultant regarding the need for repairs. The Construction Manager will ensure that the supporting soil is repaired.

At any time before or during the HDPE installation, the CQA Consultant will indicate to the Construction Manager any locations which may not be adequately prepared for the HDPE.

3.4.2.4.4 Anchor Trench Preparation

The CQA Consultant will verify that the anchor trench has been constructed according to the design Drawings and Specifications.

Slightly rounded corners will be provided in the trench so as to avoid sharp bends in the HDPE. Excessive amounts of loose soil will not be allowed to underlie HDPE in the anchor trench.

The anchor trench will be adequately drained to prevent ponding or softening of adjacent sods while the trench is open. The anchor trench will be backfilled and compacted as outlined in the project specifications.

Care will be taken when backfilling the trenches to prevent any damage to the HDPE. The CQA Consultant will observe the backfilling operation and advise the Construction Manager of any problems. Any problems will be documented by the CQA Consultant in his daily report.

3.4.2.4.5 HDPE Deployment

Panel Nomenclature

A field panel is defined as a unit of HDPE which is to be seamed in the field, i.e., a field panel is a roll or a portion of roll cut in the field.

It will be the responsibility of the CQA Consultant to ensure that each field panel be given an identification code (number or letter-number) consistent with the layout plan. This identification code will be agreed upon by the Construction Manager, Installer and CQA Consultant. This field panel identification code will be as simple and logical as possible. In general, it is not appropriate to identify panels using roll numbers since numbers established in the manufacturing plant are usually cumbersome and are related to location in the field. The CQA Consultant will establish a table or chart showing correspondence between roll numbers and field panel identification codes. The field panel identification code will be used for all quality assurance records.

The CQA Consultant will verify that field panels are installed at the locations indicated on the Installer's layout plan, as approved by the Construction Manager.

Panel Deployment Procedure

The CQA Consultant will review the panel deployment progress of the Installer (keeping in mind issues relating to wind, rain, clay liner desiccation, and other site-specific conditions) and advise the Construction Manager on its compliance with the approved panel layout drawing and its suitability to the actual field conditions. Once approved, only the Construction Manager can authorize changes to the panel deployment procedure. CQA Consultant will verify that the condition of the supporting soil does not change detrimentally during installation.

The CQA Consultant will record the identification code, location, and date of installation of each field panel.

Deployment Weather Conditions

HDPE deployment will not proceed at an ambient temperature below 32° F (0° C) or above 104° F (40° C) unless otherwise authorized, in writing, by the Construction Manager. HDPE placement will not be performed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. HDPE deployment will not be undertaken if weather conditions will preclude material seaming following deployment.

The CQA Consultant will verify that the above conditions are fulfilled. Ambient temperature will be measured by the CQA Consultant in the area in which the panels are to be deployed. The CQA Consultant will inform the Construction Manager of any weather related problems which may not allow HDPE placement to proceed.

Method of Deployment

Before the HDPE is handled on site, the CQA Consultant will verify that handling equipment to be used on the site is adequate and does not pose risk of damage to the HDPE. During handling, the CQA Consultant will observe and verify that the Installer's personnel handle the HDPE with care.

The CQA Consultant will verify the following:

- Any equipment used does not damage the HDPE by handling, trafficking, excessive heat, leakage of hydrocarbons, or other means.
- The prepared surface underlying the HDPE has not deteriorated since previous acceptance, and is still acceptable immediately prior to HDPE placement.
- Any material immediately underlying the HDPE are clean and free of debris.
- All personnel do not smoke or wear damaging shoes while working on the HDPE, or engage in other activities which could damage the HDPE.

- The method used to unroll the panels does not cause excessive scratches or crimps in the HDPE and does not damage the supporting soil.
- The method used to place the panels minimized wrinkles (especially differential wrinkles between adjacent panels).
- Adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the HDPE, has been placed to prevent uplift by wind. In case of winds, continuous loading, e.g., by sand bags, is recommended along edges of panel to minimize risk of wind flow under the panels.
- Direct contact with the HDPE is minimized, and the HDPE is protected by geotextiles, extra HDPE, or other suitable materials, in areas where excessive traffic may be expected.

The CQA Consultant will inform the Construction Manager if the above conditions are not fulfilled.

Damage and Effects

Upon delivery to the site, the CQA Consultant will conduct a surface observation of all rolls for defects and for damage. This inspection will be conducted without unrolling rolls unless defects or damages are found or suspected. The CQA Consultant will advise the Construction Manager, in writing, of any rolls or portions of rolls which should be rejected and removed from the site because they have severe flaws, and/or minor repairable flaws.

The CQA Consultant will inspect each panel, after placement and prior to seaming, for damage and/or defects. The CQA Consultant will advise the Construction Manager which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels, or portions of damaged panels, which have been rejected will be marked and their removal from the work area recorded by the CQA Consultant. Repairs will be made using procedures described in the Specifications.

Writing on the Liner

To avoid confusion, the Installer and the CQA Consultant will each use different colored markers that are readily visible for writing on the HDPE. The markers used must be semi-

permanent and compatible with the HDPE. The Installer will use a yellow marker to write on the HDPE. The CQA Consultant will use a red marker.

3.4.2.4.6 HDPE Field Seaming

Seam Layout

Before installation begins, the Installer must provide the Construction Manager and the CQA Consultant with a panel layout drawing, i.e., a drawing of the facility to be lined showing all expected seams. The CQA Consultant will review the panel layout drawing and verify that it is consistent with accepted state-of-practice. No panels may be seamed without written approval of the panel layout drawing by the Construction Manager. In addition, panels not specifically shown on the panel layout drawing may not be used without the Construction Manager's prior approval.

In general, seams should be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than 5 ft (1.5 m) from the toe of the slope, or areas of potential stress concentrations, unless otherwise authorized by the Construction Manager.

A seam numbering system compatible with the panel numbering system will be used by the CQA Consultant.

Accepted Seaming Methods

Approved processes for field seaming are extrusion welding and fusion welding. Fusion double seam welding is the preferred method for joining long, straight seams. Extrusion welding is the preferred seaming method in areas such as corners, sumps, pipe penetrations, tear repairs and cap strips where fusion double seam welding is not feasible. Use of extrusion welding will be minimized to the extent possible. Proposed alternate processes will be documented and submitted by the Installer to the Construction Manager for approval. Only apparatus which have been specifically approved by make and model will be used. The Construction Manager will submit all documentation regarding seaming methods to be used to the CQA Consultant for review.

Extrusion Process

The CQA Consultant will log ambient, seaming apparatus, and HDPE surface temperatures at appropriate intervals and report any noncompliances to the construction manager.

- The CQA Consultant will verify that:
  The Installer maintains on-site the number of spare operable seaming apparatus decided upon at the pre-construction meeting.
- Equipment used for seaming is not likely to damage the HDPE.
- Prior to beginning a seam, the extruder is purged until all heat-degraded extrudate has been removed from the barrel.
- Clean and dry welding rods or extrudate pellets are used.
- The electric generator is placed on a smooth base such that no damage occurs to the HDPE.
- Grinding will be completed no more than 1 hour prior to seaming.
- A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage.
- The HDPE is protected from damage in heavily trafficked areas.
- Exposed grinding marks adjacent to an extrusion weld will be minimized. In no instance will exposed grinding marks extend more than ¼-inch from the seamed area.
- In general, the HDPE panels are aligned to have a nominal overlap of 3 inches (75 mm) for extrusion welding. In any event, the final overlap will be sufficient to allow peel tests to be performed on the seam.
- No solvent or adhesive is used unless the product is approved in writing by the construction manager prior to use (samples will be submitted to the construction manager for testing and evaluation).
- The procedure used to temporarily bond adjacent panels together does not damage the HDPE; in particular, the temperature of hot air at the nozzle of any temporary welding apparatus is controlled such that the HDPE is not damaged or degraded.

Fusion Process

The CQA Consultant will log ambient, seaming apparatus, and HDPE surface temperatures at appropriate intervals and report any noncompliances to the construction manager. The CQA Consultant will also verify that the Installer maintains on-site the number of spare operable seaming apparatus decided upon at the pre-construction meeting:

- Equipment used for seaming is not likely to damage the HDPE.
- For cross seams, the edge of the cross seam is ground to an incline prior to welding.
- The electric generator is placed on a smooth base such that no damage occurs to the HDPE.
- A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage.
- The HDPE is protected from damage in heavily trafficked areas.
- A movable protective layer is used as required by the installer directly below each overlap of HDPE that is to be seamed to prevent buildup of moisture between the sheets and prevent debris from collecting around the pressure rollers.
- In general, the HDPE panels are aligned to have a nominal overlap of 5 inches (125 mm) for fusion welding. In any event, the final overlap will be sufficient to allow peel tests to be performed on the seam.
- No solvent or adhesive is used unless the product is approved in writing by the Construction Manager prior to use (samples will be submitted to the Construction Manager for testing and evaluation).

Seam Preparation

The CQA Consultant will verify that prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris or foreign material of any kind. If seam overlap grinding is required, the CQA Consultant must ensure that the process is completed according to the manufacturer's instructions within one hour of the seaming operation, and in a way that does not damage the HDPE. The CQA Consultant will also verify that seams are aligned with the fewest possible number of wrinkles and "fishmouths".

Trial Seams

Trial seams will be made on fragment pieces of HDPE liner to verify that conditions are adequate for production seaming. Such trial seams will be made at the beginning of each seaming period, and at least once each five hours, for each production seaming apparatus used that day. Each seamer will make at least one trial seam each day. Trial seams will be made under the same conditions as actual seams.

The trial seam sample will be at least 5 ft (1.0 m) long by 1 ft (0.3 m) wide (after seaming) with the seam centered lengthwise.

Two specimens will be cut from the sample with a 1-inch (25 mm) wide die. The specimens will be cut by the installer at locations selected randomly along the trial seam sample by the CQA Consultant. The specimens will be tested in peel using a field tensiometer. The tensiometer will be capable of maintaining a constant jaw separation rate of two inches per minute. They should not fail in the seam. If a specimen fails, the entire operation will be repeated. If the additional specimen fails, the seaming apparatus and seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful trial welds are achieved. The CQA Consultant will observe all trial seam procedures.

The remainder of the successful trial seam sample will be cut into three pieces, one to be retained in the construction manager's archives, one to be given to the installer, and one to be retained by the CQA Consultant for possible laboratory testing. Each portion of the sample will be assigned a number and marked accordingly by the CQA Consultant, who will also log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description.

If agreed upon between the Construction Manager and the CQA Consultant, and documented by the CQA Consultant in his/her daily report, the remaining portion of the trial seam sample can be subjected to destructive testing. If a trial seam sample fails a test conducted by the Geosynthetic QAL, then a destructive seam test sample will be taken from each of the seams completed by the seamer during the shift related to the considered trial seam. These samples will be forwarded to the Geosynthetic QAL and, if they fail the tests, the seam will be subjected to the "Destructive Test Failure Procedures" identified in

this CQA Plan. The conditions of this paragraph will be considered satisfied for a given seam if a destructive seam test sample has already been taken.

General Seaming Procedures

During general seaming, the CQA Consultant will be cognizant of the following:

- For fusion welding, it may be necessary to place a movable protective layer of plastic directly below each overlap of HDPE that is to be seamed. This is to prevent any moisture buildup between the sheets to be welded and prevent debris from collecting around the pressure rollers.
- If required, a firm substrate will be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.
- Fishmouths or wrinkles at the seam overlaps will be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles will be seamed and any portion where the overlap is inadequate will then be patched with an oval or round patch of the same HDPE extending a minimum of 6 inches (150 mm) beyond the cut in all directions.
- If seaming operations are carried out at night, adequate illumination will be provided.
- Seaming will extend to the outside edge of panels placed in the anchor trench.
- All cross seam tees should be extrusion welded to a minimum distance of 4 inches on each side of the tee.
- No field seaming will take place without the master seamer being present.

The CQA Consultant will verify that the approved seaming procedures are followed, and will inform the Construction Manager of any nonconformance.

Seaming Weather Conditions

Normal Weather Conditions

The normal required weather conditions for seaming are as follows:

- Ambient temperature between 32° F (0° C) and 104° F (40° C).

- Dry conditions (i.e., no precipitation or other excessive moisture, such as fog or dew).
- No excessive winds.

The CQA Consultant will verify that these weather conditions are fulfilled and notify the Construction Manager in writing if they are not. Ambient temperature will be measured by the CQA Consultant in the area in which the panels are to be placed. The Construction Manager will then decide if the installation is to be stopped or special procedures used.

Cold Weather Conditions

To ensure a quality installation, if seaming is conducted when the ambient temperature is below 32° F (0° C), the following conditions must be met:

HDPE surface temperatures will be determined by the CQA Consultant at intervals of at least once per 100 foot of seam length to determine if preheating is required. For extrusion welding, preheating is required if the surface temperature of the HDPE is below 32° F (0° C).

Preheating may be waived by the construction manager based on a recommendation from the CQA Consultant, if the installer demonstrates to the CQA Consultant's satisfaction that welds of equivalent quality may be obtained without preheating at the expected temperature of installation.

If preheating is required, the CQA Consultant will inspect all areas of HDPE that have been preheated by a hot air device prior to seaming, to ensure that they have not been overheated.

Care will be taken to confirm that the surface temperatures are not lowered below the minimum surface temperatures specified for welding due to winds or other adverse conditions. It may be necessary to provide wind protection for the seam area.

All preheating devices will be approved prior to use by the construction manager.

Additional destructive tests will be taken at an interval between 500 and 250 feet of seam length, at the discretion of the CQA Consultant.

Sheet grinding may be performed before preheating, if applicable.

Trial seaming will be conducted under the same ambient temperature and preheating conditions as the actual seams. Under cold weather conditions, new trial seams will be conducted if the ambient temperature drops by more than 5° F from the initial trial seam test conditions.

Warm Weather Conditions

At ambient temperatures above 104° F, no seaming of the HDPE will be permitted unless the installer can demonstrate to the satisfaction of the construction manager that HDPE seam quality is not compromised.

Trial seaming will be conducted under the same ambient temperature conditions as the actual seams.

At the option of the CQA Consultant, additional destructive tests may be required for any suspect areas.

3.4.2.4.7 Nondestructive Seam Testing

Concept

The Installer will nondestructively test all field seams over their full length using a vacuum test unit, air pressure test (for double fusion seams only), or other approved method. The purpose of nondestructive tests is to check the continuity of seams. It does not provide quantitative information on seam strength. Nondestructive testing will be carried out as the seaming work progresses, not at the completion of all field seaming.

For all seams, the CQA Consultant will:

- Observe nondestructive testing procedures.
- Record location, data, test unit number, name of tester, and outcome of all testing.
- Inform the Installer and Construction Manager of any required repairs.
  Any seam that cannot be nondestructively tested will be cap-stripped with the same HDPE. The cap-stripping operations will be observed by the CQA Consultant and Installer for uniformity and completeness.

Vacuum Testing

The following procedures are applicable to vacuum testing.

The equipment will consist of the following:
A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, a porthole or valve assembly, and a vacuum gauge.

- A pump assembly equipped with a pressure controller and pipe connections.
- A rubber pressure/vacuum hose with fittings and connections.
- A soapy solution.
- A bucket and wide paint brush, or other means of applying the soapy solution.
  The following procedures will be followed:
- Energize the vacuum pump and reduce the tank pressure to approximately 5 psi (10 in. of Hg) (35 kPa) gauge.
- Wet a strip of HDPE approximately 12 inches x 48 inches (0.3 m x 1.2 m) with the soapy solution.
- Place the box over the wetted area.
- Close the bleed valve and open the vacuum valve.
- Ensure that a leak-tight seal is created.
- For a period of not less than 10 seconds, apply vacuum and examine the HDPE through the viewing window for the presence of soap bubbles.
- If no bubble appears after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches (75 mm) overlap, and repeat the process.
- All areas where soap bubbles appear will be marked and repaired.

Air Pressure Testing

The following procedures are applicable to double fusion welding which produces a double seam with an enclosed space.

The equipment will consist of the following:

- An air pump (manual or motor driven), equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi (160 and 200 kPa) and mounted on a cushion to protect the HDPE.
- A rubber hose with fittings and connections.
- A sharp hollow needle, or other approved pressure feed device.
  The following procedures will be followed:
- Seal both ends of the seam to be tested.
- Insert needle or other approved pressure feed device into the air channel created by the fusion weld.
- Insert a protective cushion between the air pump and the HDPE.
- Energize the air pump to a pressure between 25 and 30 psi (160 and 200 kPa), close valve, allow 2 minutes for pressure to stabilize, and sustain pressure for at least 5 minutes.
- If loss of pressure exceeds 4 psi (30 kPa) or does not stabilize, locate faulty area and repair in accordance with Section 4.9.3.
- Cut opposite end of tested seam area once testing is completed to verify continuity of the air channel. If air does not escape, locate blockage and retest unpressurized area. Seal the cut end of the air channel.
- Remove needle or other approved pressure feed device and seal.

Test Failure Procedure

- The Installer will complete any required repairs in accordance with the requirements of the Specifications. For repairs, the CQA Consultant will:
- Observe the repair and testing of the repair.
- Mark on the HDPE that the repair has been made.
- Document the repair procedures and test results.

3.4.2.4.8 Destructive Seam Testing

Concept

Destructive seam tests will be performed at selected locations in accordance with the requirements of the Specifications. The purpose of these tests is to evaluate seam strength. Seam strength testing will be done as the seaming work progresses, not at the completion of all field seaming.

Location and Frequency

The CQA Consultant will select locations where seam samples will be cut out for laboratory testing. Those locations will be established as follows:

A minimum frequency of one test location per 1,000 ft (150 m) of seam length performed by each welder. This minimum frequency is to be determined as an average taken throughout the entire facility.

Test locations will be determined during seaming at the CQA Consultant's discretion. Selection of such locations may be prompted by suspicion of overheating, contamination, offset welds, or any other potential cause of imperfect welding.

One additional CQA destructive seam test will be performed for every 10 destructive tests required by the specifications with a minimum of two CQA destructive tests per HDPE layer.

The Installer will not be informed in advance of the locations where the seam samples will be taken.

The Construction Manager or CQA Consultant may elect to do additional tests at his discretion.

Sampling Procedures

Samples will be cut by the Installer at locations chosen by the CQA Consultant as the seaming progresses so that laboratory test results are available before the HDPE is covered by another material. The CQA Consultant will:

- Observe sample cutting.
- Assign a number to each sample, and mark it accordingly.
- Record sample location on layout drawing.
- Record reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the HDPE).

All holes in the HDPE resulting from destructive seam sampling will be immediately repaired in accordance with repair procedures described in the Specification. The continuity of the new seams in the repaired area will be tested.

Sample Dimensions

At a given sampling location, two types of samples will be taken by the Installer. First, two samples for field testing should be taken. Each of these samples will be cut with a 1-inch (25 mm) wide die, with the seam centered parallel to the width. The distance between these two samples will be 42 inches (1.1 m). If both samples pass the field tests described below, a sample for laboratory testing will be taken.

The sample for laboratory testing will be located between the samples for field testing. The sample for laboratory testing will be 12 inches (0.3 m) wide by 42 inches (1.1 m) long with the seam centered lengthwise. The sample will be cut into three parts and distributed as follows:

- One portion to the Installer for optional laboratory testing, 12 inches x 12 inches (0.3 m x 0.3 m)
- One portion for QAL testing, 12 inches x 18 inches (0.3 m x 0.5 m) and
- One portion to the Construction Manager for archive storage, 12 inches x 12 inches (0.3 m x 0.3 m).

Final determination of the sample sizes will be made at the pre-construction meeting.

Field Testing

The two 1-inch (25 mm) wide strips will be tested in the field using a tensiometer for peel and will not fail according to the criteria in the Specifications. The tensiometer will be

capable of maintaining a constant jaw separation rate of 2 in. per minute. If the test passes in accordance with this section, the sample qualifies for testing in the laboratory. If it fails, the seam should be repaired. Final judgement regarding seam acceptability, based on the failure criteria will be made by the Construction Manager.

The CQA Consultant will witness all field tests and mark all samples and portions with their number. The CQA Consultant will also log the date and time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail description, and attach a copy to each sample portion.

Laboratory Testing

Destructive test samples will be packaged and shipped, if necessary, under the responsibility of the CQA Consultant in a manner which will not damage the test sample. The Construction Manager will be responsible for storing the archive samples. Test samples will be tested by the Geosynthetic QAL.

Testing will include "seam strength" and "peel adhesion". These terms are defined in the specifications. The minimum acceptable values to be obtained in these tests are indicated in the Specifications. At least 5 specimens will be tested in each shear and peel. Specimens will be selected alternately by test from the samples (i.e., peel, shear, peel, shear...). A passing test will meet the minimum acceptable values in at least 4 of the 5 specimens tested for each method.

The QAL will provide verbal test results no more than 24 hours after they receive the samples. The CQA Consultant will review laboratory test results as soon as they become available, and make appropriate recommendations to the Construction Manager.

Destructive Test Failure Procedures

The following procedures will apply whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetic QAL, or by field tensiometer. The Installer has two options:

The Installer can repair the seam between any two passing test locations.

The Installer can trace the welding path to an intermediate location (at 10 ft (3 m) minimum from the point of the failed test in each direction) and take a sample with a 1 in. (25 mm) wide die for an additional field test at each location. If these additional samples pass the test, then full laboratory samples are taken. If these laboratory samples pass the tests, then the seam is repaired between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be repaired.

All acceptable repaired seams will be bound by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft (50 m) of repaired seam, a sample taken from the zone in which the seam has been repaired must pass destructive testing. Repairs will be made in accordance with Specifications.

The CQA Consultant will document all actions taken in conjunction with destructive test failures.

3.4.2.4.9 Defects and Repairs

Identification

All seams and non-seam areas of the HDPE will be examined by the CQA Consultant for identification of defects, holes, busters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the HDPE helps to detect defects, the surface of the HDPE will be clean at the time of examination. The HDPE surface will be cleaned by the installer if the amount of dust or mud inhibits examination.

Evaluation

Each suspect location both in seam and non-seam areas will be nondestructively tested using the methods described in the Specifications as appropriate. Each location which fails the nondestructive testing will be marked by the CQA Consultant and repaired by the installer. Work will not proceed with any materials which will cover locations which have been repaired until appropriate nondestructive and laboratory test results with passing values are available.

Repair Procedures

Any portion of the HDPE exhibiting a flaw, or failing a destructive or nondestructive test, will be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure will be agreed upon between the Construction Manager, Installer, and CQA Consultant.

The repair procedures available include:

- Patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
- Spot welding or seaming, used to repair small tears, pinholes, or other minor, localized flaws.
- Capping, used to repair large lengths of failed seams.
- Extrusion welding the flap, used to repair areas of inadequate fusion seams, which have an exposed edge. Repairs of this type will be approved by the CQA Consultant, and will not exceed 50 ft (15 m) in length.
- Removing bad seam and replacing with a strip of new material welded into place.

For any repair method, the following provisions will be satisfied:

- Surfaces of the HDPE which are to be repaired using extrusion methods will be abraded no more than one hour prior to the repair.
- All surfaces will be clean and dry at the time of the repair.
- All seaming equipment used in repairing procedures will meet the requirements of the project CQA Plan.
- Patches or caps will extend at least 6 inches (150 mm) beyond the edge of the defect, and all corners of patches will be rounded with a radius of approximately 3 inches (75 mm).

Repair Verification

Each repair will be numbered and logged. Each repair will be nondestructively tested using the methods described in the Specifications as appropriate. Repairs which pass the

nondestructive test will be taken as an indication of an adequate repair. Repairs more than 150-ft long may be of sufficient extent to require destructive test sampling, at the discretion of the CQA Consultant. Failed tests indicate that the repair will be redone and retested until a passing test results. The CQA Consultant will observe all nondestructive testing of repairs and will record the number of each repair, date, and test outcome.

Large Wrinkles

When seaming of the HDPE is completed, and prior to placing overlying materials, the CQA Consultant will indicate to the Construction Manager which wrinkles should be cut and reseamed by the Installer. The number of wrinkles to be repaired should be, kept to an absolute minimum. Therefore, wrinkles should be located during the coldest part of the installation process, while keeping in mind the forecasted weather to which the uncovered HDPE may be exposed. The HDPE will be inspected for wrinkles every morning by the CQA Consultant and the results of the inspection will be documented. On completion of HDPE installation, it will be inspected for wrinkles by the CQA Consultant. Unacceptably large wrinkles will be removed after this final inspection. Wrinkles are considered to be large when the HDPE can be folded over on to itself. Seams produced while repairing wrinkles will be tested as outlined above.

When placing overlying material on the HDPE, every effort must be made to minimize wrinkle development. If possible, cover should be placed during the coolest weather available. In addition, small wrinkles should be isolated and covered as quickly as possible to prevent their growth. The placement of cover materials will be observed by the CQA Consultant to ensure that wrinkle formation is minimized.

SECTIONFOUR Extraction Wells

The following sections describe the CQAP for the Site R extraction wells. Detailed information regarding materials and construction methods is provided in the Specifications. The Specifications are one component of quality assurance and discuss, among other items, the well acceptance criteria. These criteria, along with monthly inspection criteria, are discussed in the following sections.

4.1 ORGANIZATION, KEY PERSONNEL, AND RESPONSIBILITIES

Generally, key personnel, their authority and responsibilities with respect to the CQA process were discussed above in Section 1.0. Additional entities for the Extraction Wells are as follows:

Designer – Golder Associates is the Designer responsible for performing the engineering design, preparing the associated Plans and Specifications, managing construction, and providing field quality assurance for the extraction wells. The Designer is responsible for approving all design and specification changes and making design clarifications necessitated during construction of the project components. Mark Sandfort will be the Project Manager for Golder Associates for this project. The Project Manager will supervise the progress of the extraction well installations to ensure adherence to the Specifications. It will be Mr. Sandfort's responsibility to identify any scope changes and to communicate those changes to the involved parties. The Project Manager is a primary contact with the client. Field operations will be conducted by Mr. Mark Haddock, who will act as Field Operations Manager and Site Health and Safety officer for Golder. In this capacity, Mr. Haddock will be responsible for all field activities, including installation of the wells, implementation of field QA/QC procedures, hydrogeological observations, and Site health and safety issues that are associated with Golder's work on the project.

4.2 WELL EVALUATION CRITERIA

Each well will be developed and evaluated after it is fully installed. Development and testing are discussed in the Specifications. Each well will be tested in order to verify that it will perform adequately, according to the criteria discussed below.

- Each well should be able to produce the maximum required flow rate of 667 gpm.

- The well should be able to produce clear water with a turbidity index of less than 5 NTU (USEPA test Method 180.1), unless the aquifer stratigraphy is such that this low turbidity is not achievable. Pumping phase of well development has been omitted, thereby making 5 NTU turbidity initially impossible.
- The well should be developed sufficiently so that it produces water free of drilling fluids.
- The well should be developed to its maximum specific capacity (no increase in well specific capacity should be observed following successive development periods).
- The casings, screens, and caps should be set to the depths specified in the Technical Specifications. Well depths have been modified to screen the entire sandy aquifer at EW-1 and EW-3, as modified by set available lengths of well materials.
- All well identification numbers, dates of completion, and permit numbers should be imprinted inside the cap of the pitless adapter.
- Well screen size was based on information available prior to drilling, and on the proposed pumping capacity of the wells at the time of well design. Based on subsequent developments, and on conditions encountered in the field, both these criteria changed. In addition, original design called for placing pumps within the well casing, rather than within the well screens. Variation to include screening of the upper, finer-grained portion of the aquifer prohibited pump placement above the screen.

5.1 ORGANIZATION, KEY PERSONNEL, AND RESPONSIBILITIES

Key personnel, their authority and responsibilities with respect to the CQA process were discussed above in Section 1.0.

5.2 PROPOSED SUBMITTALS AND TESTING

5.2.1 HDPE Pipe and Fittings

5.2.1.1 Materials

Submittals will be required for all proposed HDPE pipe and fittings. These submittals will be checked to assure that the requirements of the drawings and specifications are met.

5.2.1.2 Joining

Spot checks will be made to assure that Contractor is following the joining methods and procedures prescribed by the Specifications and the recommendations of the manufacturer.

5.2.1.3 Testing Protocols

The pressure testing procedure will be carefully monitored to assure that the Contractor is performing the testing as prescribed in the Specification.

5.2.1.4 Acceptance/Rejection Criteria

The acceptance criteria for the pressure testing are defined in the Specification, and the results of the pressure testing will be judged against those criteria and the pipeline will be ultimately accepted or rejected based on the pressure testing. Adherence to the planned grades of the pipeline will also be a basis for acceptance or rejection. If the pipeline has the minimum cover and is level or rising toward the high points in the line, it will be accepted. If it fails to meet this criterion, it will be rejected, because air will accumulate in the line at the highs between dips.

5.2.2 Ductile Iron Pipe and Fittings

The requirements for submittals, joining, testing protocols, and acceptance/rejection for HDPE pipe and fittings will also apply to ductile iron pipe and fittings.

5.2.3 Valves

The requirements for submittals, joining, testing protocols, and acceptance/rejection for HDPE pipe and fittings will also apply to the valves. Certain valve manufacturers and models are called for in the Specifications, but equal valves will be considered if submitted and accepted or rejected based on their characteristics and specifications.

5.2.4 Instrumentation

The instrumentation consists of the magnetic flowmeter and its appurtenant signal transmission equipment and the continuous sampling instrument. The manufacturers and models for these instruments have been indicated in the Specifications, but equal equipment will be considered if submitted and either accepted or rejected based on performance characteristics, accuracy, ease of use, and reliability.

5.2.5 Manhole

One manhole is required at the high point in the pipeline and will contain the combination air valve to release air during initial filling and admit air to prevent a vacuum from forming in the line. The Specifications require the Contractor to perform a survey of the pipeline alignment and select the location for the manhole based on the survey. The final location could change if the as-built grades of the line vary from the as-designed grades based on the survey. The location of the manhole will be accepted or rejected based on the criterion that it be located at the high point and the line be level or rising toward the manhole on both the upstream and downstream sides. The proposed location of the manhole will be submitted twice: once after the pre-construction ground surface survey is performed and again after the line has been installed and its as-built profile has been surveyed. The manhole will be a precast concrete unit set on a cast-in-place concrete base slab. Shop drawings will be submitted for the manhole, base slab, frame, and lid, and will be accepted or rejected based on compliance with the requirements of the Specifications and drawings. The materials will be inspected upon delivery and accepted or rejected based on compliance with the approved shop drawings.

5.2.6 Excavation, Backfill, and Bedding

In all areas, the earth excavated from the trench may be placed back in the trench. The Specification and Drawings call for clean sand bedding to be placed and compacted. The bedding will first be placed and compacted to the bottom of pipe level. The pipe will then be laid in the trench and sand backfill placed and compacted around it. Because the pipe will be empty at the time the backfill is placed, the Contractor will have to compact the backfill with care in order not to lift the pipe. This is a construction detail that will be worked out with the Contractor in advance so that the grade of the pipe is maintained during the backfilling operation. Where the line crosses streets (Riverview and Mobile Avenues), the compacted sand will extend to the top of the trench. For the remainder of the line, the backfill above the bedding sand will be placed in layers and sufficiently compacted so that it will not settle under its own weight. No testing will be performed on the backfill above the bedding sand, but the placement and compaction will be observed to assure that there is sufficient compaction to preclude excessive post-construction surface settlement. CQAP for placement, compaction and testing will generally be performed in accordance with Section 2.1.1.4, Earthwork within Section 2, Site Development and the Earthwork Specifications, except as specifically stated herein.

5.2.7 Sliplining 30-In. Diameter Reinforced Concrete Water Pipe

The pipeline diameter will be increased from 12.75 in. OD to 20 in. OD on the river (west) side of the levee and slipped into the existing abandoned 30-in. diameter water line under the levee and railroad tracks immediately landward of the levee. The annulus between the 20-in. OD HDPE pipe and the ID of the 30-in. diameter pipe will be grouted throughout the portion of the pipe that is under the levee. The focus of the QA for this part of the pipeline will be the fusion joints in the HDPE pipe and the grouting of the annulus. The pipeline will be pressure tested in this reach before grouting so that if leaks are discovered, the pipe can be extracted, rejoined at defective joints, and re-slipped through the 30-in. diameter line. The CQA representative will witness the joint fusion, sliplining operation, pressure testing and grouting full time. The grout volume will be compared with the theoretical volume of the annulus to assure that the annulus is completely filled.

SECTIONSIX Automated Control and Monitoring System (ACMS)

The construction quality assurance plan (CQAP) for the automated control and monitoring system (ACMS) addresses quality assurance requirements during installation of the ACMS. Quality control will be the responsibility of equipment manufacturers and installers of the various components of the ACMS.

In summary, the ACMS is a primary component of the Groundwater Migration Control System (GMCS). The primary function of the ACMS will be to automatically monitor stage levels of the Mississippi River and adjust pumping rates of the three extraction wells. A secondary function of the ACMS will be to monitor the water level in four pairs of piezometers, which will be equally spaced along the west leg of the U-shaped barrier wall. One piezometer of each pair will be located inside the barrier wall and one will be located outside the wall. The piezometers will be used to monitor groundwater gradients across the barrier wall. A more detailed description of the ACMS, including technical Specifications and manufacturers literature, is provided in Volume 1, Section 6.

6.1 ORGANIZATION, KEY PERSONNEL AND RESPONSIBILITIES

An overview of the GMCS Quality Assurance project team organization, key personnel and responsibilities is provided in Section 1. This section of the CQAP will be specific to QA activities associated with installation and initial start-up of the ACMS.

Designer

The Designer is the individual and/or firm responsible for the preparation of the design, including Drawings and project-specific Specifications for the ACMS. The Designer is URS Corporation (URS).

Construction Quality Assurance (CQA) Consultant

The Construction Quality Assurance (CQA) Consultant will be responsible for observing and documenting activities related to the quality assurance of the production and installation of ACMS on behalf of Solutia. The CQA Consultant will be URS. The CQA Consultant will prepare a Daily Field Report which summarizes all work activities, measurements and tests associated with installation of the ACMS.

The CQA Consultant is responsible for implementation of the project CQAP.

6.2 ACMS INSTALLATION QA REQUIREMENTS

The CQA Consultant will have the following responsibilities during installation of the ACMS:

1. Review site-specific documentation and required contractor submittals including ACMS design drawings, technical specifications, manufacturers' equipment literature and specifications, and all approved shop drawings.
2. Review all changes to design drawings and specifications as issued by the designer.
3. Attend all quality assurance related meetings
4. Review all manufacturer and installer certifications and documentation and make appropriate recommendations.
5. Review the installer's personnel and qualifications for conformance with the qualifications of the project.
6. Review and document receipt of all instruments, sensor and equipment calibration data sheets.
7. Prepare a daily log of installer activities and submit to Construction Manager. Identify any activities or issues requiring further action or clarification.
8. Report and document any unapproved deviations from the CQA Plan to the Construction Manager.
9. Observe and document ACMS unit testing and full-scale integration testing. Document that all tests were performed in accordance with approved test plans. Resolve deviations between approved test plans with actual field test procedures used and results with Construction Manager.

6.3 FINAL ACCEPTANCE TEST QA REQUIREMENTS

The selected ACMS installation contractor will be required to submit a detailed final system acceptance test plan for review by the Construction Manager and QA representative. This final acceptance test plan will be a formal contractor submittal and will detail all system tests to confirm that the as-installed system meets or exceeds all requirements set forth in the contract documents.

SECTIONSIX Automated Control and Monitoring System (ACMS)

The CQA Consultant will have the following responsibilities as part of the system installation closeout and during performance of the final acceptance test:

1. Observe and document point-to-point verification tests on all installed components from the field devices to measurement and control unit (MCU) and to the ACMS host PC. Include applicable test documentation and forms as required by approved installer test plans. System controls should be tested at each unit level.
2. Observe and document verification test of "blackout" startup of the system.
3. Review installation contractor's as-built submittals including:
   - Process and instrumentation diagram (P&ID)for the installed system
   - Point listing, with variable acronym, software address, point type and engineering units
   - Control Logic Diagram
   - Wiring diagrams including termination nomenclature, location and wiring identification
   - Calibration sheets for all installed instrumentation
   - All software, hardware and licenses necessary to operate, maintain, update and modify the system.
   - O&M Manual
   - Training Materials.

Figures

Figure 1
Organization Chart

GMCS Site R